MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

BOP2024 – PRINCIPLES OF OPERATION RESEARCH

(All Sections/Groups)

28 February 2020
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **SIX (6)** pages including cover page with Section A and Section B.
2. Section A consists of **TWO (2)** application questions. Section B consists of **TWO (2)** analysis questions.
3. Attempt **ALL** the questions.
4. Please write all your answers in the Answer Booklet and Graph Paper provided.
5. The distribution of the marks for each question is given. Total marks 100.

SECTION A: APPLICATION QUESTIONS (50%)

QUESTION 1 (25 MARKS)

a) A canning company produces two sizes of cans, X_1 regular and X_2 large. The cans are produced in 10,000 can lots. The cans are processed through a stamping operation and a coating operation. The company has 30 days available for both stamping and coating. A lot of regular size cans requires 2 days to stamp and 4 days to coat, whereas a lot of large cans requires 4 days to stamp and 2 days to coat. A lot of regular size cans earns \$800 profit, and a lot of large size cans earns \$900 profit. In order to fulfill its obligations under a shipping contract, the company must produce at least nine lots. The company wants to determine the number of lots to produce of each size can (X_1 and X_2) in order to maximum profit.

i) Construct a linear programming model for this problem. (5 marks)

ii) Solve this model by using graphical analysis. (8 marks)

b) The Monggo Chocolate Pte. Ltd has developed the following linear programming problem:

Max $X_1 + 2X_2$

s.t. $2X_1 + X_2 \leq 100$

$2X_1 + 3X_2 \leq 240$

$3X_1 + 4X_2 \geq 360$

Unfortunately, it is infeasible. In revision, Monggo drops the original objective and establishes the three goals.

Goal 1: Don't exceed 100 in constraint 1.

Goal 2: Don't fall short of 360 in constraint 3.

Goal 3: Don't exceed 240 in constraint 2.

Present the goal programming model. (8 marks)

Continued...

c) The optimal solution of the linear programming problem is at the intersection of constraints 1 and 2.

Max $2X_1 + X_2$
s.t.
$4X_1 + X_2 \leq 400$
$4X_1 + 3X_2 \leq 600$
$X_1 + 2X_2 \leq 300$
$X_1, X_2 \geq 0$

i) Over what range can the coefficient of X_1 vary before the current solution is no longer optimal? (2 marks)
ii) Over what range can the coefficient of X2 vary before the current solution is no longer optimal? (2 marks)

QUESTION 2 (25 MARKS)

a) A real estate investor is interested in purchasing condominium property in Kuala Lumpur. The three most preferred condominiums are listed along with criteria weights and rating information. Which condominium is preferred?

		Ratings		
Criteria	**Weight**	**Park Shore**	**The Terrace**	**Gulf View**
Cost	5	5	6	5
Location	4	7	4	9
Appearance	5	7	4	7
Parking	2	5	8	5
Floor plan	4	8	7	5
Swimming pool	1	7	2	3
View	3	5	4	9
Kitchen	4	8	7	6
Closet space	3	6	8	4

(10 marks)

b) Max $140X + 100Y$

st

$4X + 2Y \leq 200$
$8X + 6Y \leq 480$
$X, Y \geq 0$

i) Show the constraints into equations with slack variables. (3 marks)
ii) Build the initial simplex tableau. (3 marks)
iii) Produce the pivot column. (3 marks)
iv) Produce the pivot row and pivot number. (3 marks)
v) Build the second simplex tableau. (3 marks)

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SECTION B: ANALYSIS QUESTIONS (50%)

QUESTION 1 (25 MARKS)

a) Blueberries are to be transported from three plantation regions to two canneries. Intermediate stops at a consolidation station are possible.

Plantation	Supply	Station	Cannery	Capacity
A	1200	South	Y	2500
B	1500	North	Z	3000
C	2000			

Shipment costs are shown in the table below. Where no cost is given, shipments are not possible. Where costs are shown, shipments are possible in either direction. Draw a network model diagram for this problem.

	A	B	C	S	N	Y	Z
A		1		5		3	
B				4	5		
C				6	3		
South					2	2	4
North						5	9
Y							2
Z							

(11 marks)

b) AKK Sdn Bhd is an accounting firm that has three new clients (Halim, Fang and Ravi). Project leaders will be assigned to the three clients. Based on the different backgrounds and experiences of the leaders, the various leader-client assignments differ in terms of projected completion times. The possible assignments and the estimated completion times in days are as follows:

	Clients		
Project Leader	**Halim**	**Fang**	**Ravi**
Ahmad	5	8	16
Kuok	7	11	20
Krishnan	11	12	17

Construct a new network representation of this problem.

(10 marks)

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c) As part of John's application for a loan to buy Lakeside Farm, a property he hopes to develop as a bed-and-breakfast operation, the prospective owner has projected:

Monthly fixed cost (loan payment, taxes, insurance, maintenance)	$6,000
Variable cost per occupied room per night	$ 20
Revenue per occupied room per night	$ 75

i) Identify the expression for total cost per month. Assume 30 days per month. (2 marks)

ii) Present the expression for total revenue per month. (2 marks)

QUESTION 2 (25 MARKS)

a) Relate the Economic Order Quantity (EOQ) with Planned Shortages, Economic Order Quantity (EOQ) with Production Lot Size and Economic Order Quantity (EOQ) with Quantity Discounts models. (9 marks)

b) Klasse Electronics Sdn Bhd produces three TV models, QLED8K, UHD TV and Curved TV. The profits per unit are RM730, RM1,050 and RM1,450, respectively. The production requirements per unit are as follows:

	Number of Main Board	Number of Backlight Inverter	Manufacturing Time (hours)
QLED8K (Q)	1	1	12
UHD TV (U)	1	2	24
Curved TV (C)	1	4	36

The linear programming model for the problem is as follows:

Max $730Q + 1{,}050U + 1{,}450C$

s.t.

$1Q + 1U + 1C \leq 2{,}000$ Main Board

$1Q + 2U + 4C \leq 3{,}200$ Backlight Inverter

$12Q + 24U + 36C \leq 2{,}400$ Manufacturing time

$Q, U, C \geq 0$

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The computer solution (Spreadsheet 1) showed the following information:

SPREADSHEET 1

Optimal Objective Value = 16440.00000

Variable	Value	Reduced Cost
Q	90.00000	0.00000
U	130.00000	0.00000
C	0.00000	-24.00000

Constraint	Slack/Surplus	Dual Price
1	0.00000	41.00000
2	0.00000	42.00000
3	320.00000	0.00000

Variable	Objective Coefficient	Allowable Increase	Allowable Decrease
Q	730.00000	120.00000	150.50000
U	1050.00000	310.00000	80.00000
C	1450.00000	240.00000	Infinite

Constraint	RHS Value	Allowable Increase	Allowable Decrease
1	2000.00000	800.00000	400.00000
2	3200.00000	800.00000	1200.00000
3	2400.00000	Infinite	3200.00000

i) Find the optimum solution and the value of the objective function. (4 marks)

ii) Identify the binding constraints. (2 marks)

iii) Which constraints show excess capacity? How much in excess? (2 marks)

iv) If the profit for Curved TV were increased to RM1,680 per unit, would the optimal solution change? Use the information from **SPREADSHEET 1** to answer this question. (2 marks)

v) If the profit for QLED8K is increased by RM60 per unit, the profit for UHD TV is decreased by RM20 per unit and the profit for Curved TV is increased by RM40 per unit. Would the optimal solution change? Explain. (4 marks)

vi) If the number of main board available for production is increased by 1,000, will the dual price for that constraint change? Interpret. (2 marks)

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